Soils

SC Envirothon Coaches' Workshop

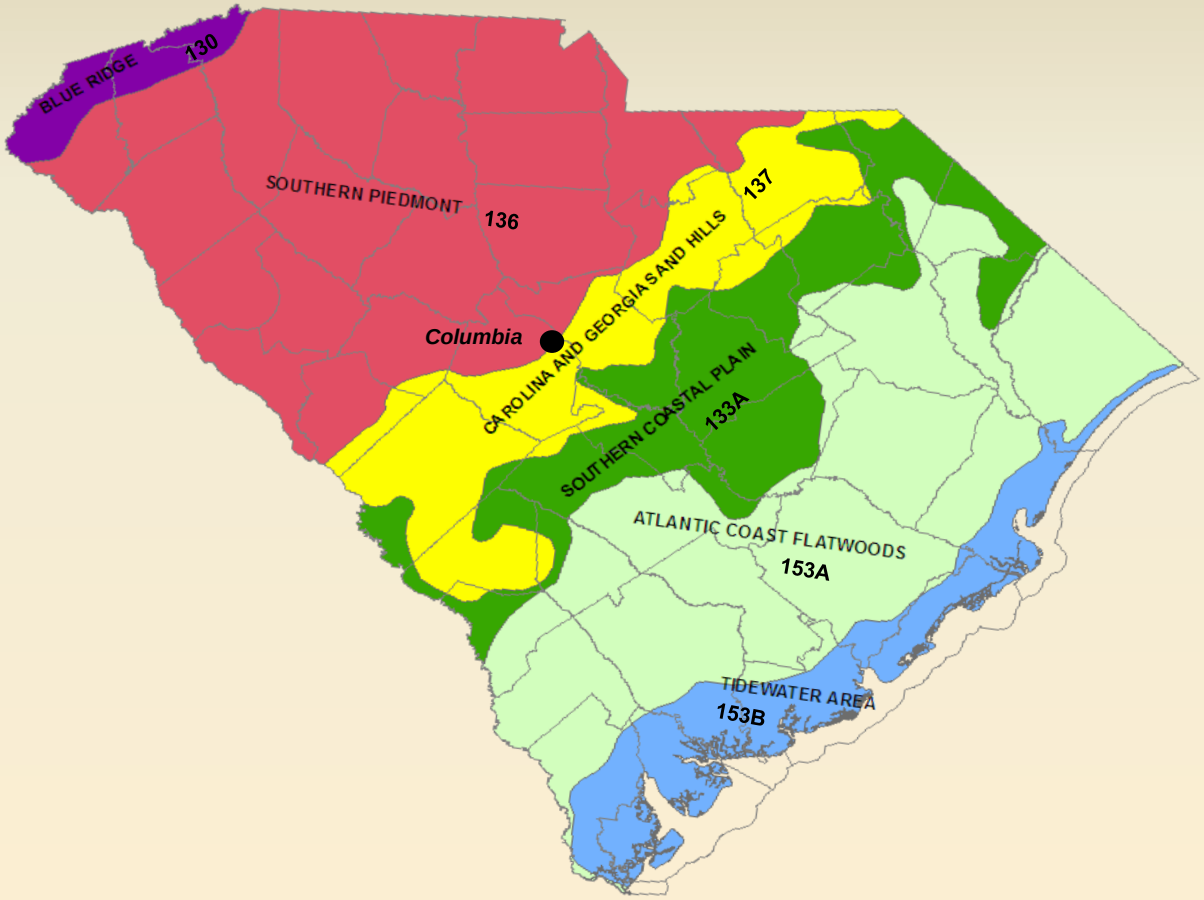
Columbia, SC

February 6, 2016

Objectives

- Define SC's Major Land Resource Areas
- Define soil
- Define various soil properties
- Discuss the soil survey/web soil survey/soilweb
- Define soil health

Major Land Resource Areas (MLRA)



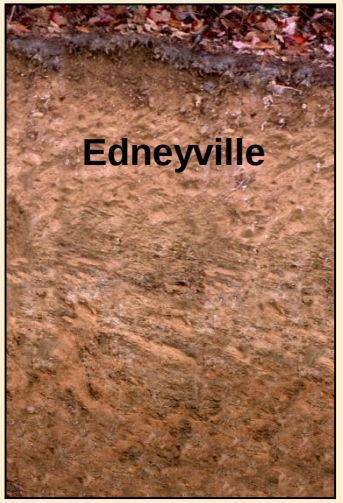
Blue Ridge

Area: 2% of state
Elevation: 1,200-3,554’

Geology
Metamorphic rocks:
granite gneiss, schist

Land of Waterfalls

Soils
loamy
Edneyville
Saluda



Piedmont

Area: 32% of state
Elevation: 400-1,200’

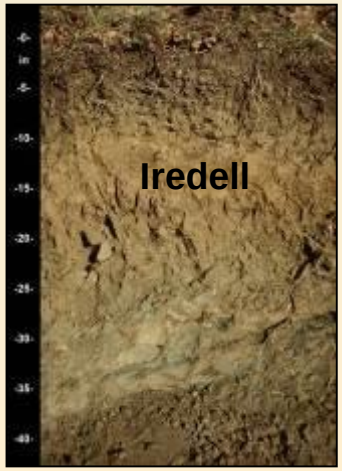
<u>Geology</u>
Igneous and metamorphic rocks:
granite, gneiss, diabase
Sedimentary rocks:
siltstone (Triassic Basin, Chesterfield)

Spartanburg County; 1933
Site of 1st SES erosion control project in the southeastern U.S.

Berry Gully - Before

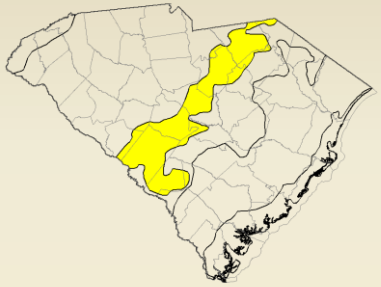
Berry Gully - After

<u>Soils</u>
deep, red, clayey
Cecil, Appling
high shrink-swell
Iredell, Brewback



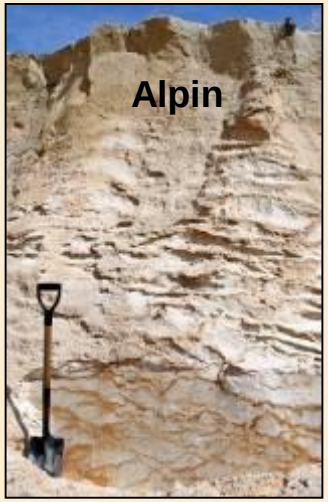
Sand Hills

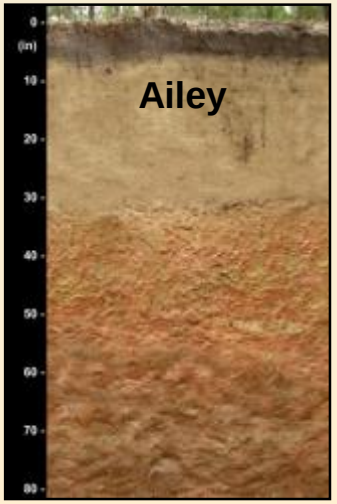
Area: 15% of state
Elevation: 200-600’



Geology
Eolian sands
Ancient river deposits
Weathered clays

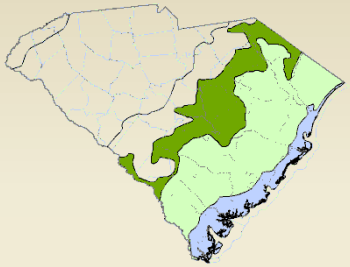
Soils
sandy to fine-loamy
Alpin, Ailey



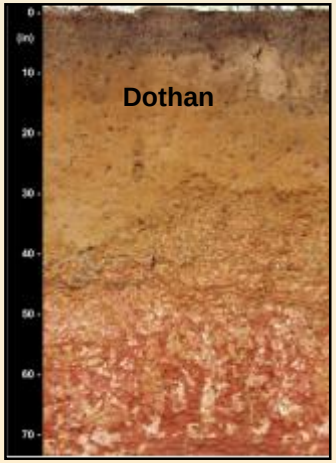


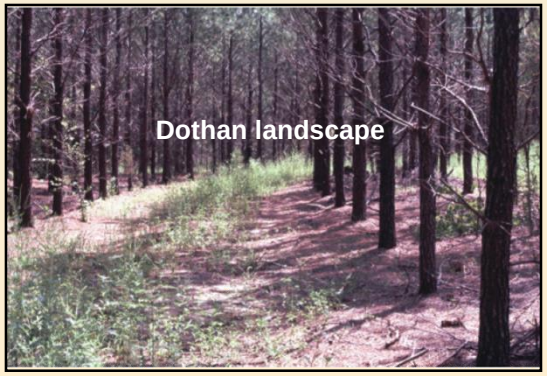
Coastal Plain

Area: 50% of state
Elevation: 0-640’



Geology
Marine deposits
River deposits



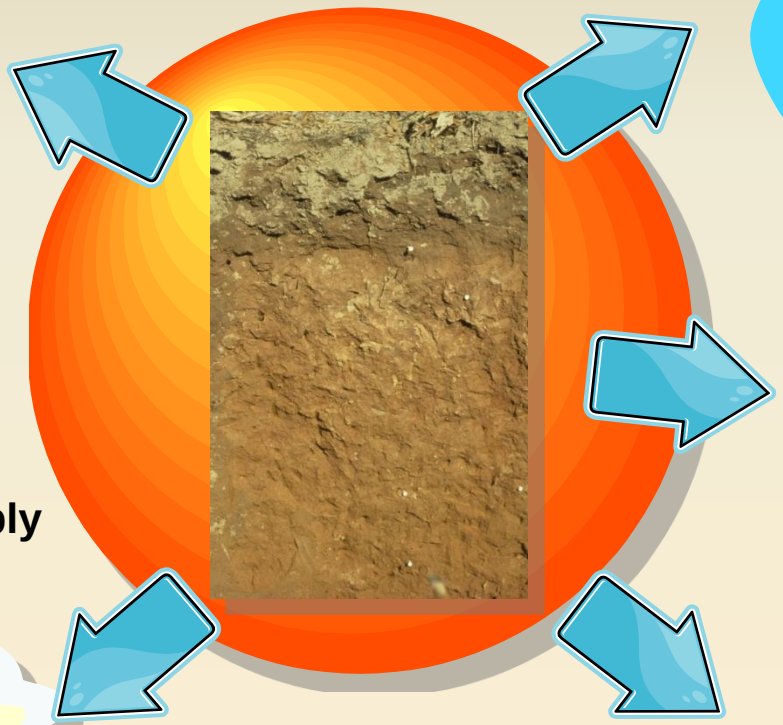


Soils
sandy to clayey
well drained to very poorly drained
Dothan (well drained)
Rains (poorly drained)

What is Soil?

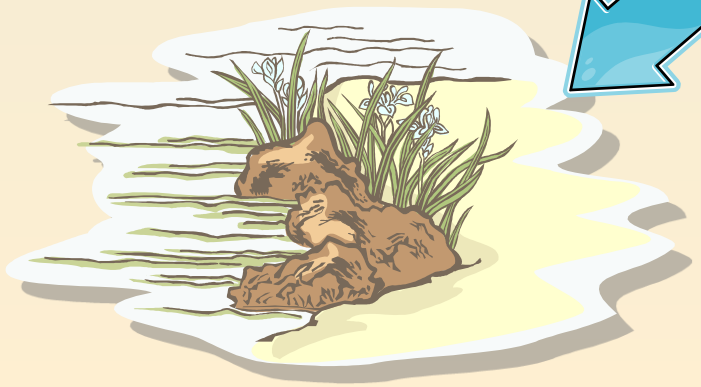
Medium for plant growth

Recycling system for nutrients and organic wastes



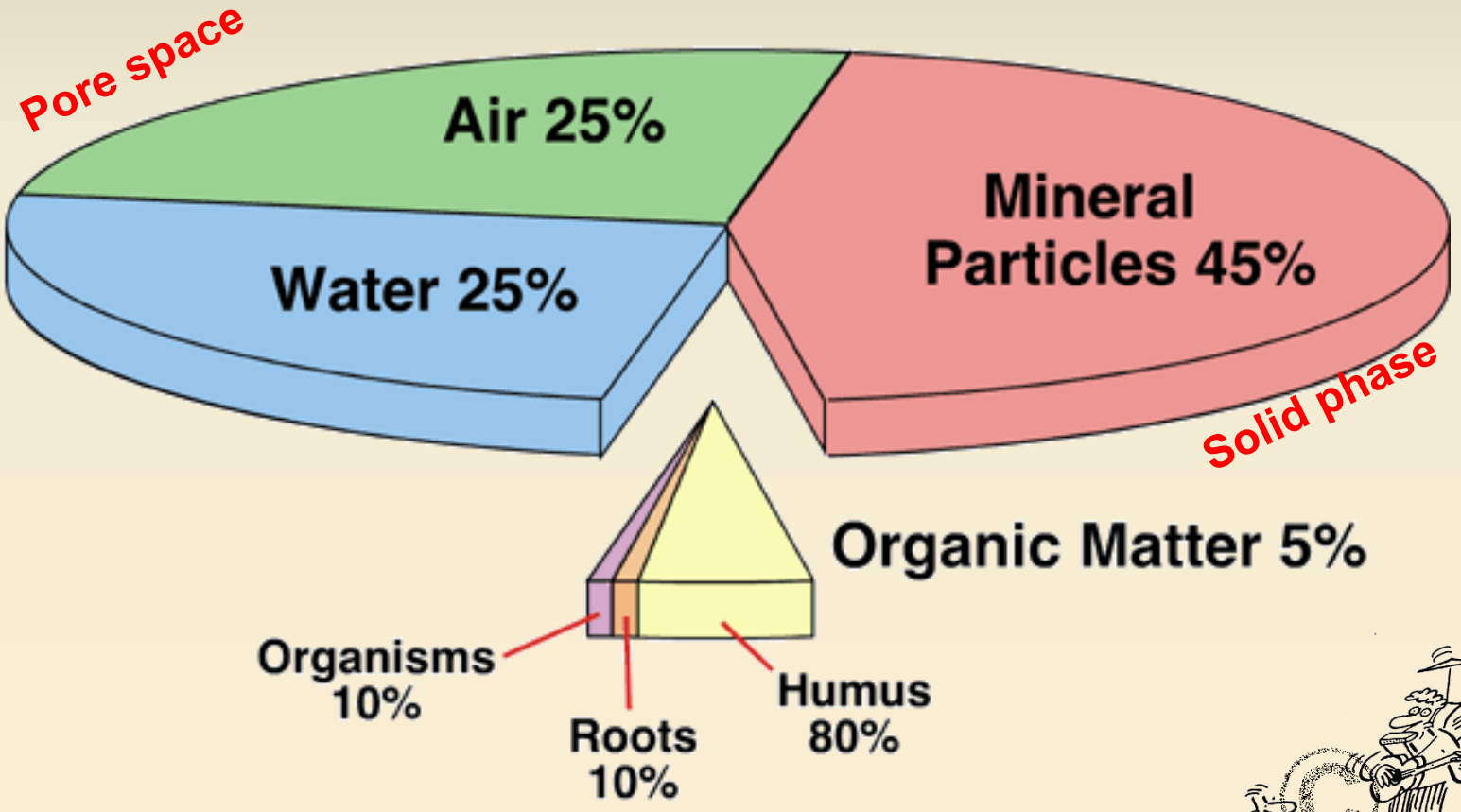
Habitat for soil organisms

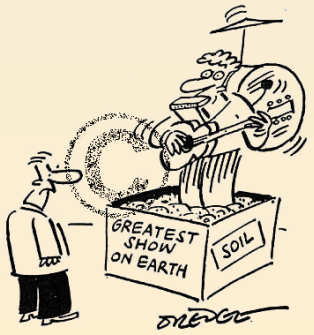
System for water supply and purification



Engineering medium

The “Ideal” Soil





Soil Forming Factors

parent material

topography

climate

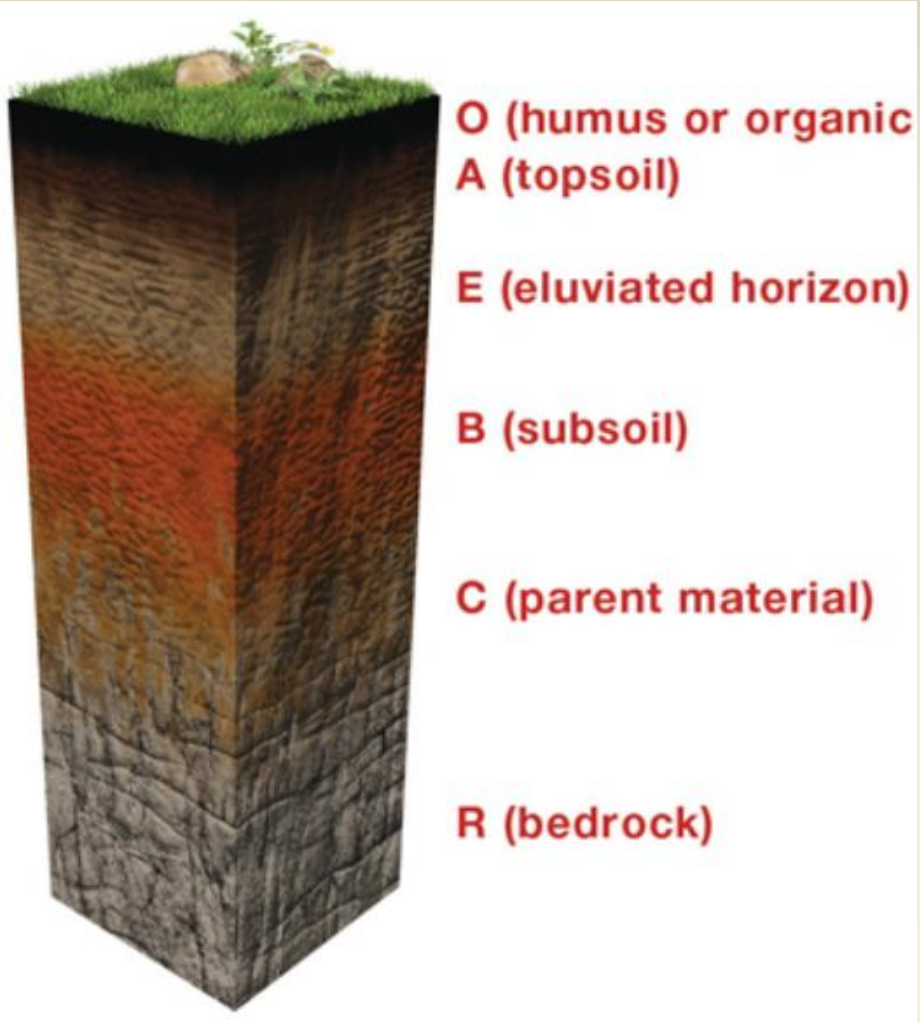
living organisms

time

Soil Horizons

Master Horizons

- O horizon (organic)
  - predominantly organic matter (litter and humus)
- A horizon (mineral)
  - zone of organic matter accumulation (topsoil)
- E horizon (mineral)
  - zone of eluviation (loss of clay, Fe, Al)
- B horizon (mineral)
  - zone of accumulation (clay, Fe, Al, $CaCO_3$, salts…) -- subsoil
  - forms below O, A, or E horizon
- C horizon (mineral)
  - little or no pedogenic alteration, unconsolidated parent material, soft bedrock
- R horizon (rock)
  - hard, continuous bedrock



Soil Texture

Soil Texture

Soil Texture = % Sand, Silt, & Clay

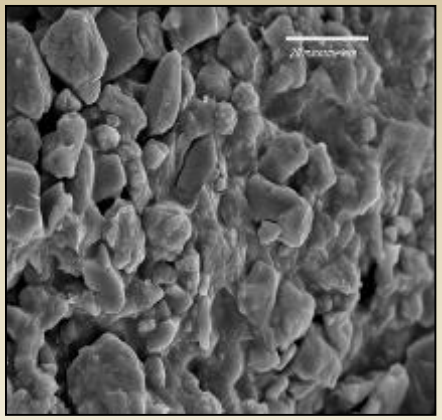
- Soil texture is the single most important physical property of the soil. Knowing the soil texture alone will provide information about:
  - water and nutrient holding capacity
  - water movement
  - soil mechanics
  - suitability/potentials for many ag and non-ag uses
    - homes, nitrate leaching, P Index, septic suitability, stormwater runoff,…..

Sand

- 0.05 mm - 2 mm
- Visible without microscope
- Feels gritty
- Sand grains usually quartz if sand looks white or many minerals if sand looks brown
- Some sands in soil will be brown, yellow, or red because of Fe and/or Al oxide coatings
- Considered non-cohesive
  - does not stick together in a mass unless it is very wet
- Low specific surface area
- Sand has less nutrients for plants than silt and clay
- Voids between sand particles promote free drainage and entry of air
- Holds little water and is prone to drought

Terry Cooper, Univ. of Minnesota

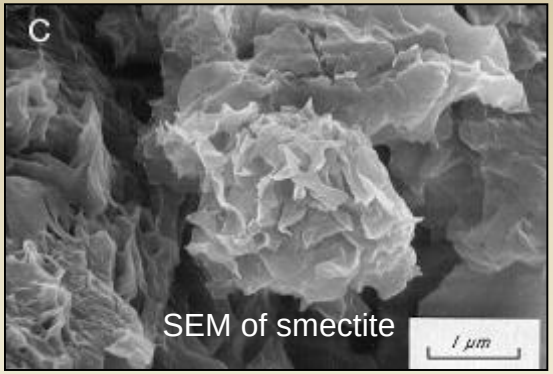
Silt



- 0.002 mm - 0.05 mm
- Not visible without microscope
- Floury feel
  - smooth like silly putty
- Quartz often dominant mineral in silt since other minerals have weathered away
- Wet silt does not exhibit stickiness, plasticity, malleability
- Smaller particles retain more water for plants and have slower drainage than sand
- Easily washed away by flowing water
  - highly erosive
- Holds more plant nutrients than sand
- Silt trivia
  - Yellow River in China gets its name from the erosion of loess, a high silt material

Clay

- < 0.002 mm
- Flat plates or tiny flakes
- Small clay particles are colloids
  - if suspended in water will not settle
- Large surface area
  - spoonful will cover a football field
- Wet clay is very sticky and plastic
- Easily formed into long ribbons
- Pores spaces are very small and convoluted
  - movement of water and air very slow
- Water holding capacity
  - tremendous capacity to adsorb water; not all available for plants
- Shrink swell
  - none to considerable depending on the type of clay
- Soil strength and shrink/swell affects buildings, roads, and foundations
- Chemical adsorption is large

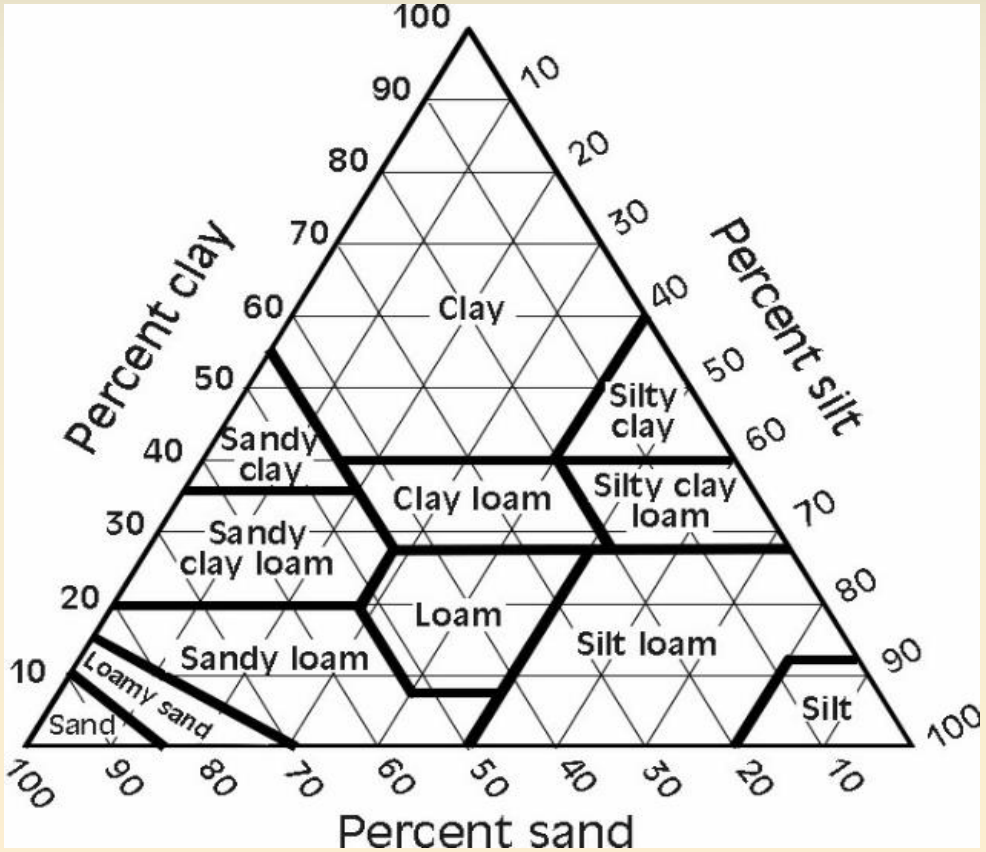


Terry Cooper, Univ. of Minnesota

Soil Textural Classes -- USDA

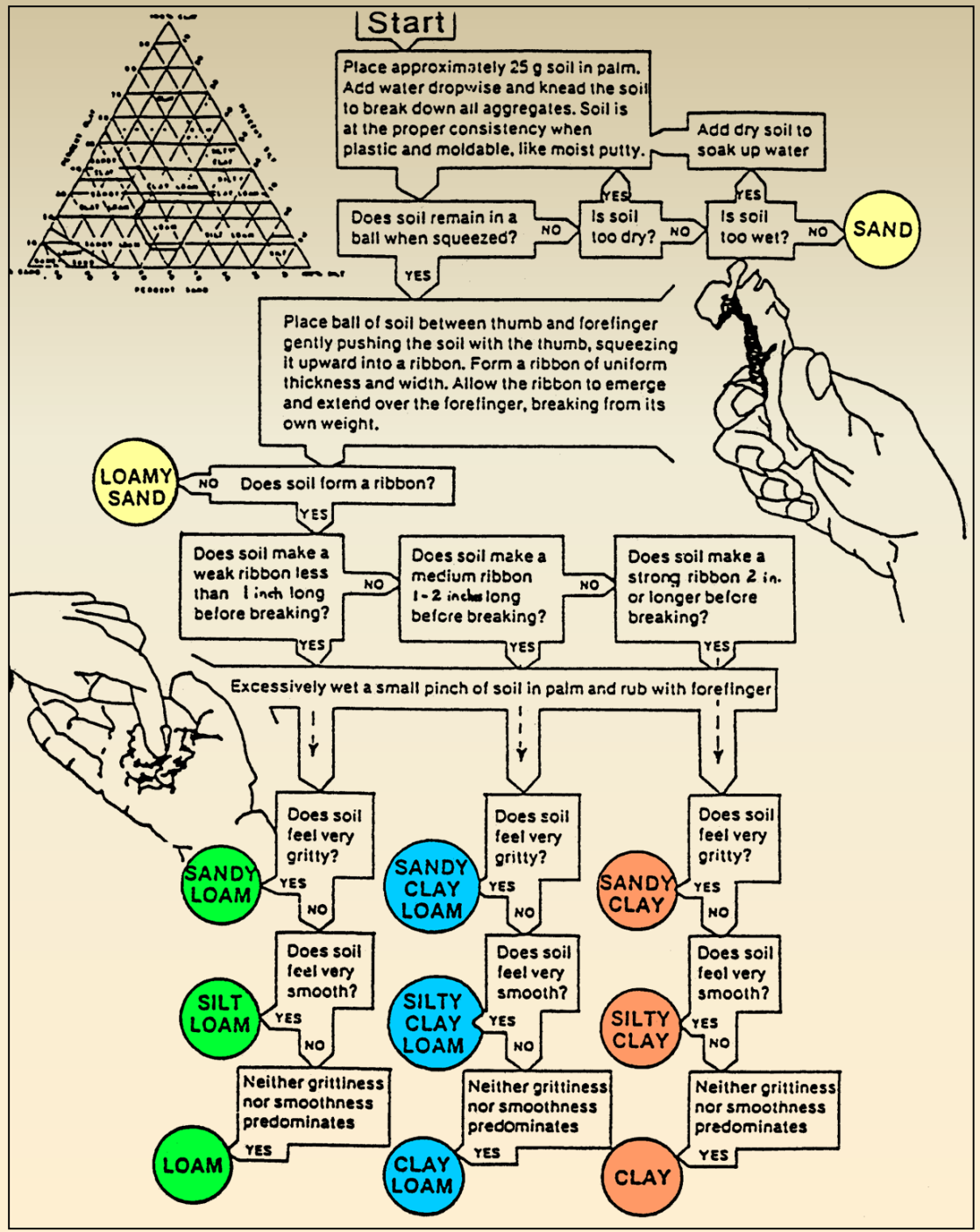
Combinations of sand, silt, and clay

1. sand
2. loamy sand
3. sandy loam
4. loam
5. silt loam
6. silt
7. sandy clay loam
8. clay loam
9. silty clay loam
10. sandy clay
11. clay
12. silty clay



Texture Flowchart

Texturing soil by the "Feel" method.




4
8
12
16
20
24
28
Soil Color

Soil Color

- Most easily determined soil property
- Important characteristic in separating soil horizons

Color charts

Munsell Notation

Universal standard for soil color.

7.5 YR 4/3

Number and letter symbols represents the **Hue.**

Hue represents the dominant color of the soil
Notation is at the top right of the color book
Y=Yellow, R=Red, G=Green, B=Blue, YR=Yellow Red

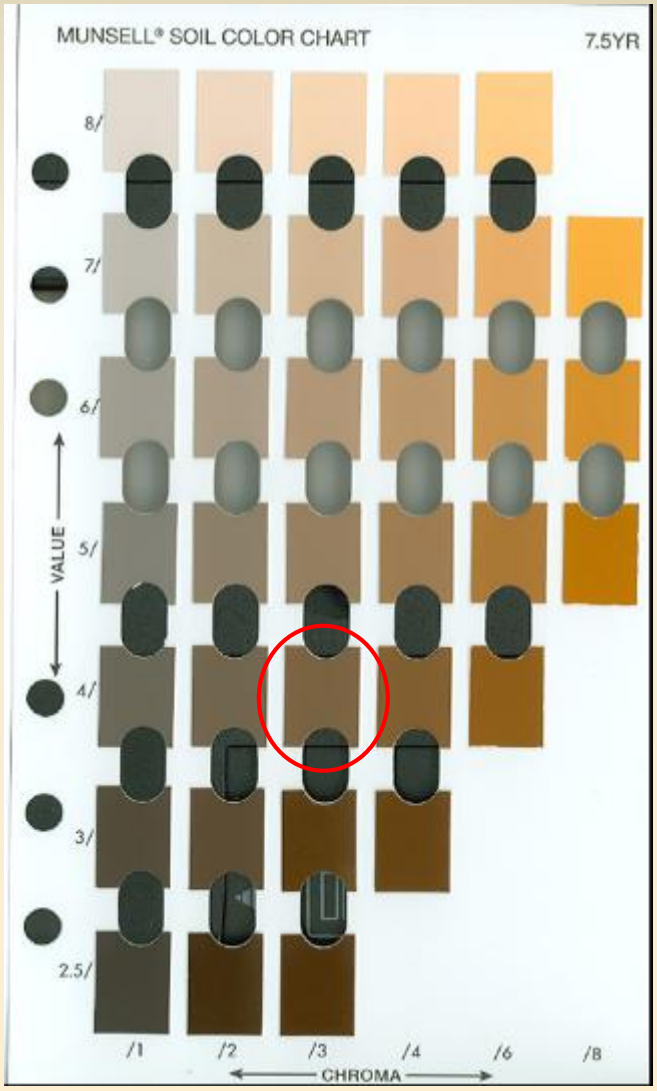
7.5 YR 4 / 3

The number before the slash is the **Value**.

- Lightness of a color. 0=pure black; 8=pure white.
- Notation at left side of color book.

The number after the slash is the **Chroma**.

- Intensity of a color. 1=less intense; 8=most intense.
- Notation at bottom of color book.

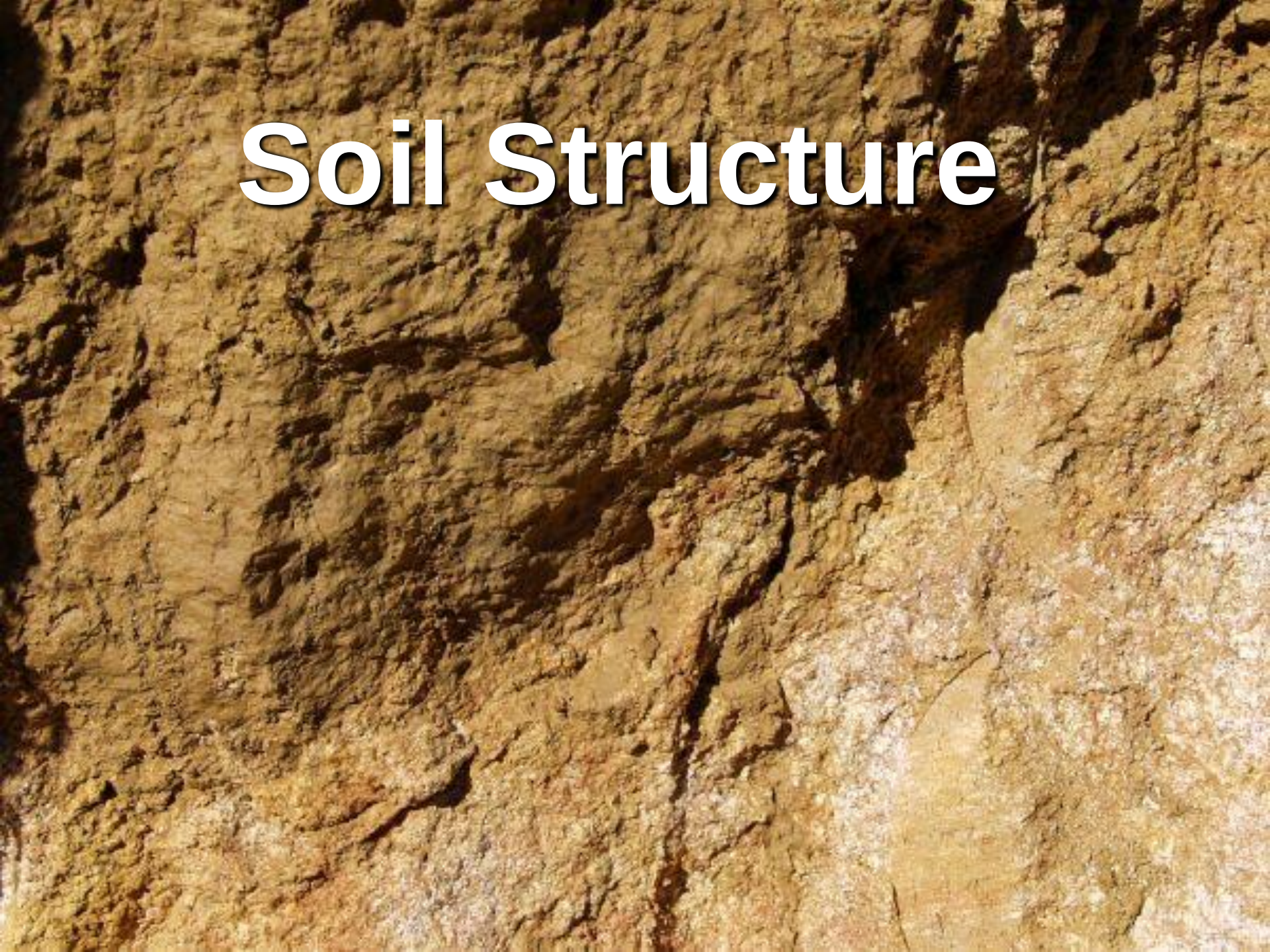


Why is Color Important?

- Infer soil characteristics such as:
  - drainage class
  - organic matter content
  - provenance of soil (where it came from)

- Color is affected by:
  - organic matter content
    - the higher the organic matter content, the darker the soil
  - oxidation/reduction state of the soil
    - presence of Fe – orange, red, yellow, brown
    - absence of Fe – gray

Soil Structure



What is Soil Structure?

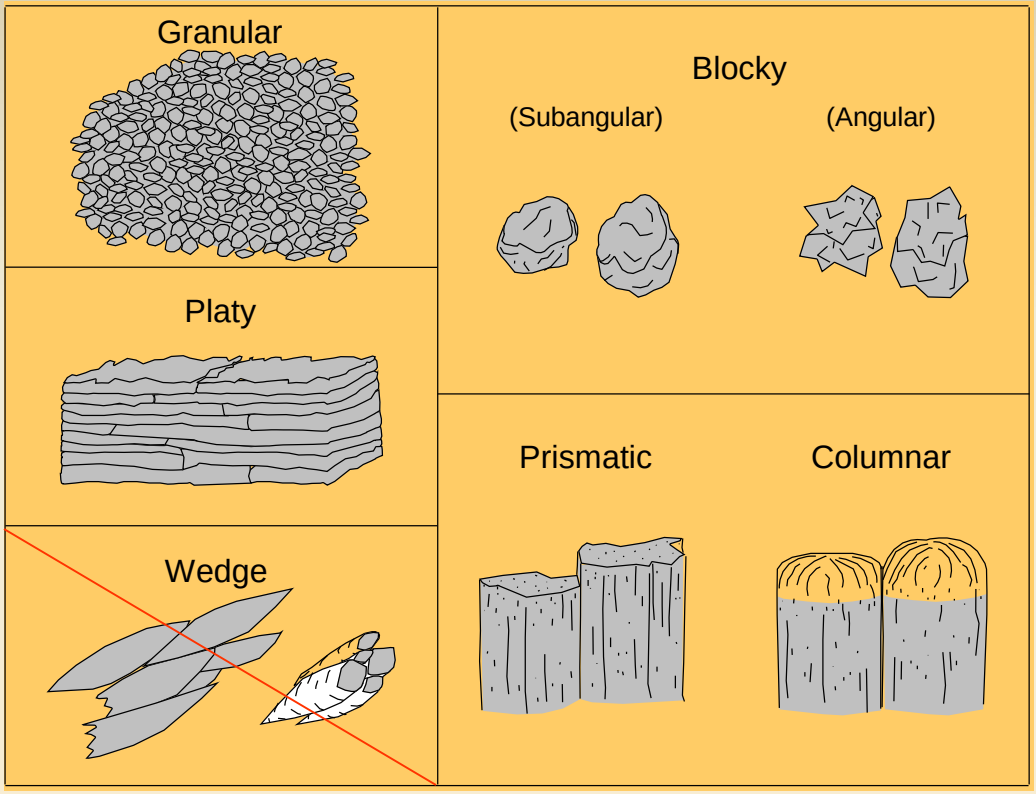
- arrangement of soil particles into aggregates
- Individual units are called a **PEDS (Latin, *earth*)**

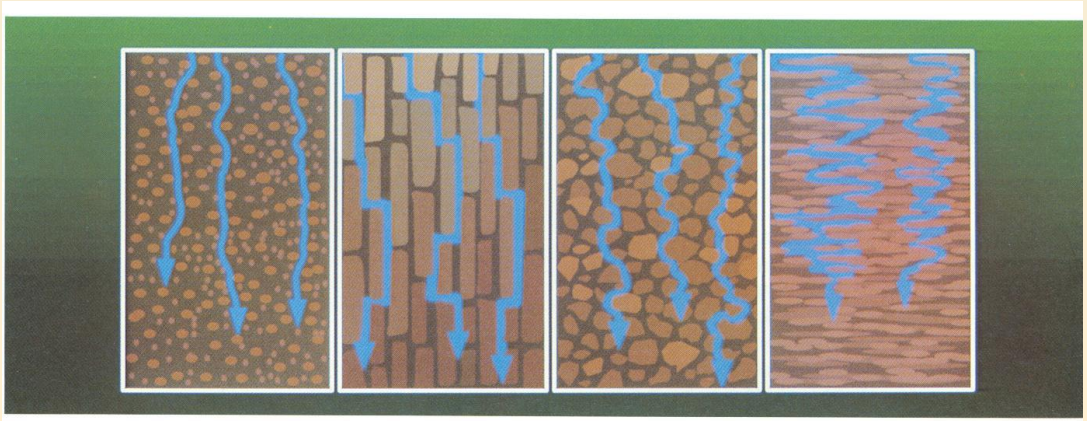
Why is Structure Important?

- Influences
  - water movement
  - aeration
  - porosity

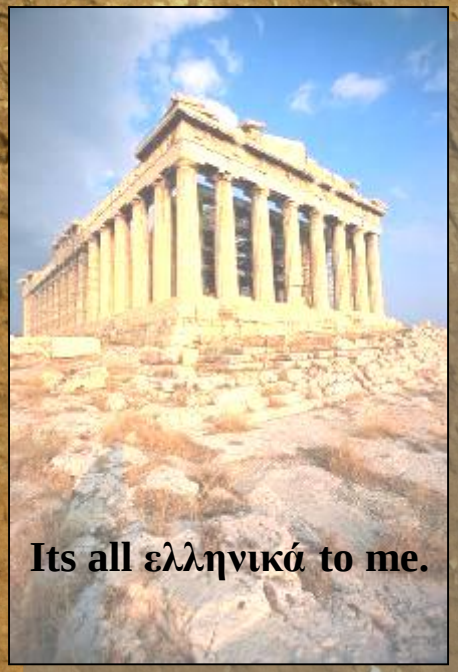
important indicator of soil health

Soil Structure Types

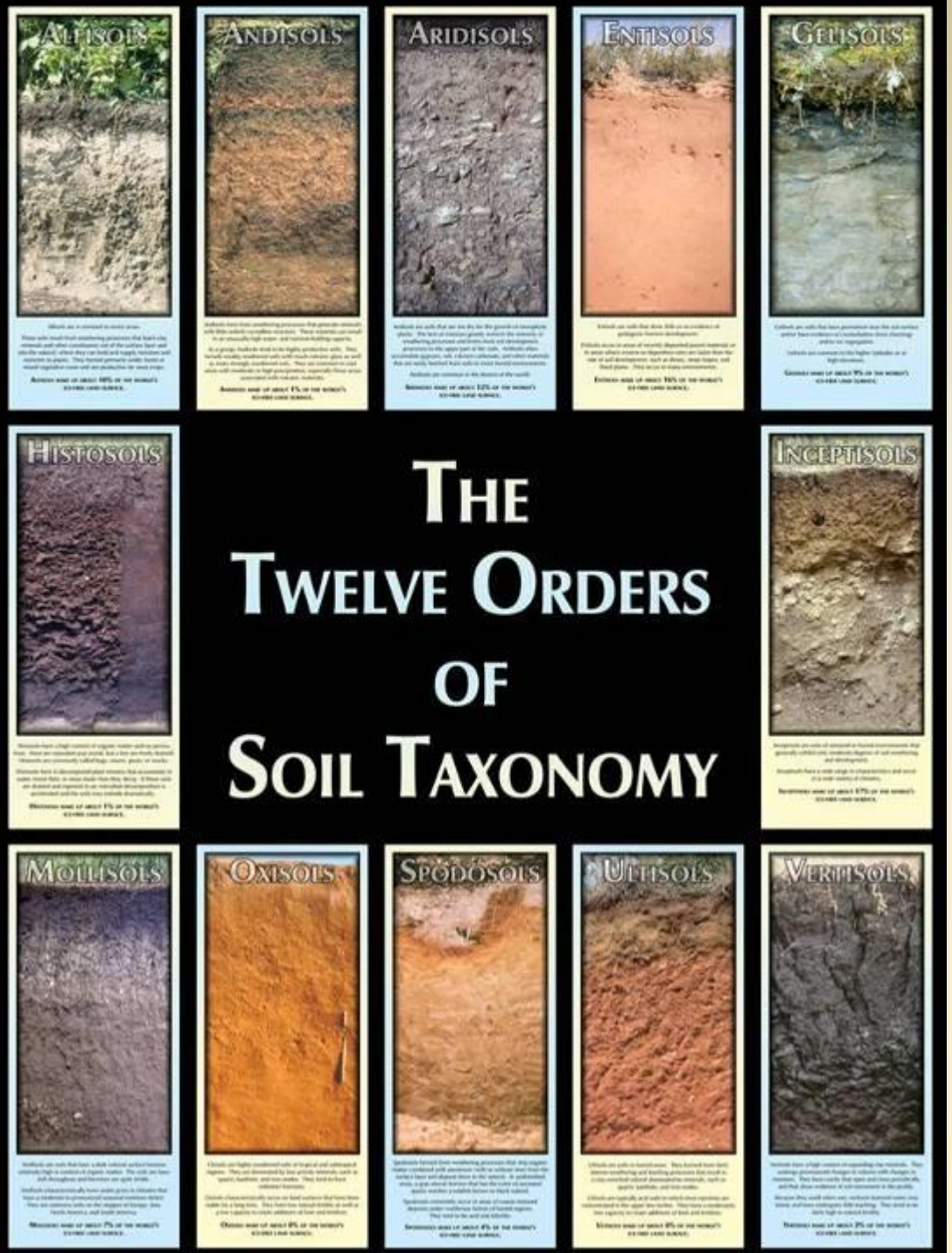




Soil Taxonomy



Fine, kaolinitic, thermic Typic Kanhapludults



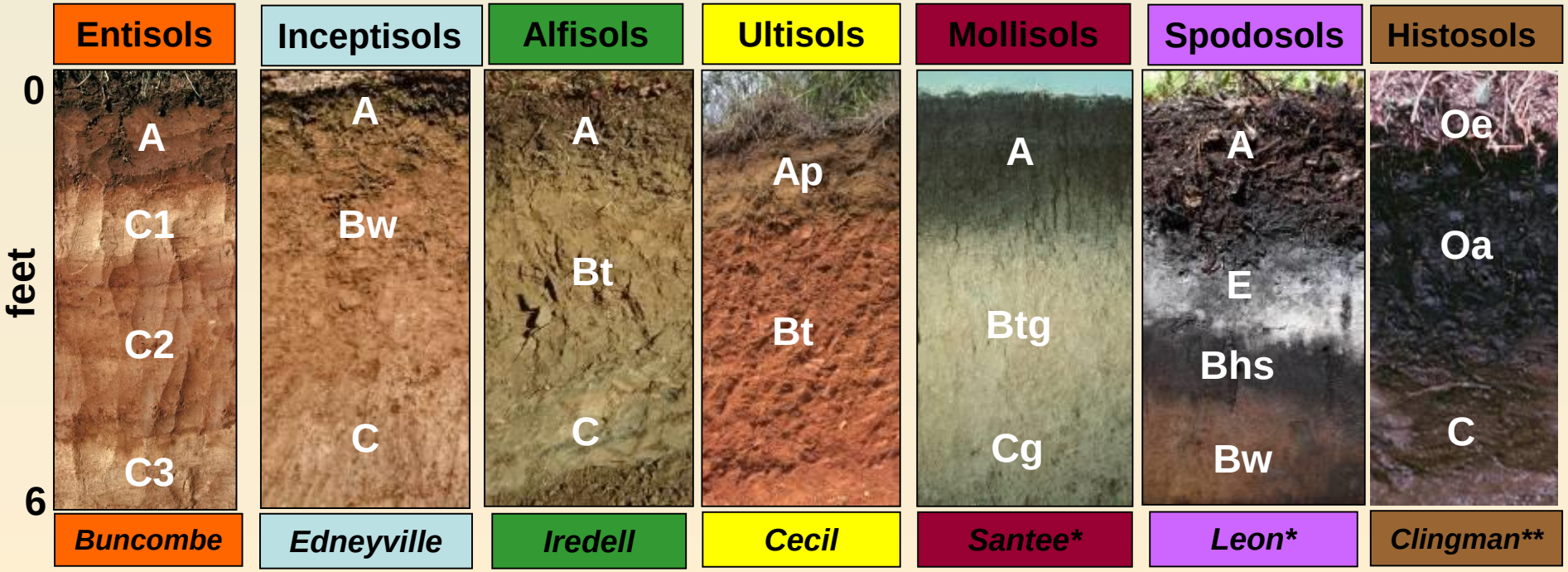
Soil Taxonomy is the basic system of soil classification for making and interpreting soil surveys.

Why Classify?

- Show relationships
- Remember properties
- Establish groups for various purposes and uses
- Develop new knowledge and relationships
- Communication for the discipline of soil science

Soil Orders in South Carolina

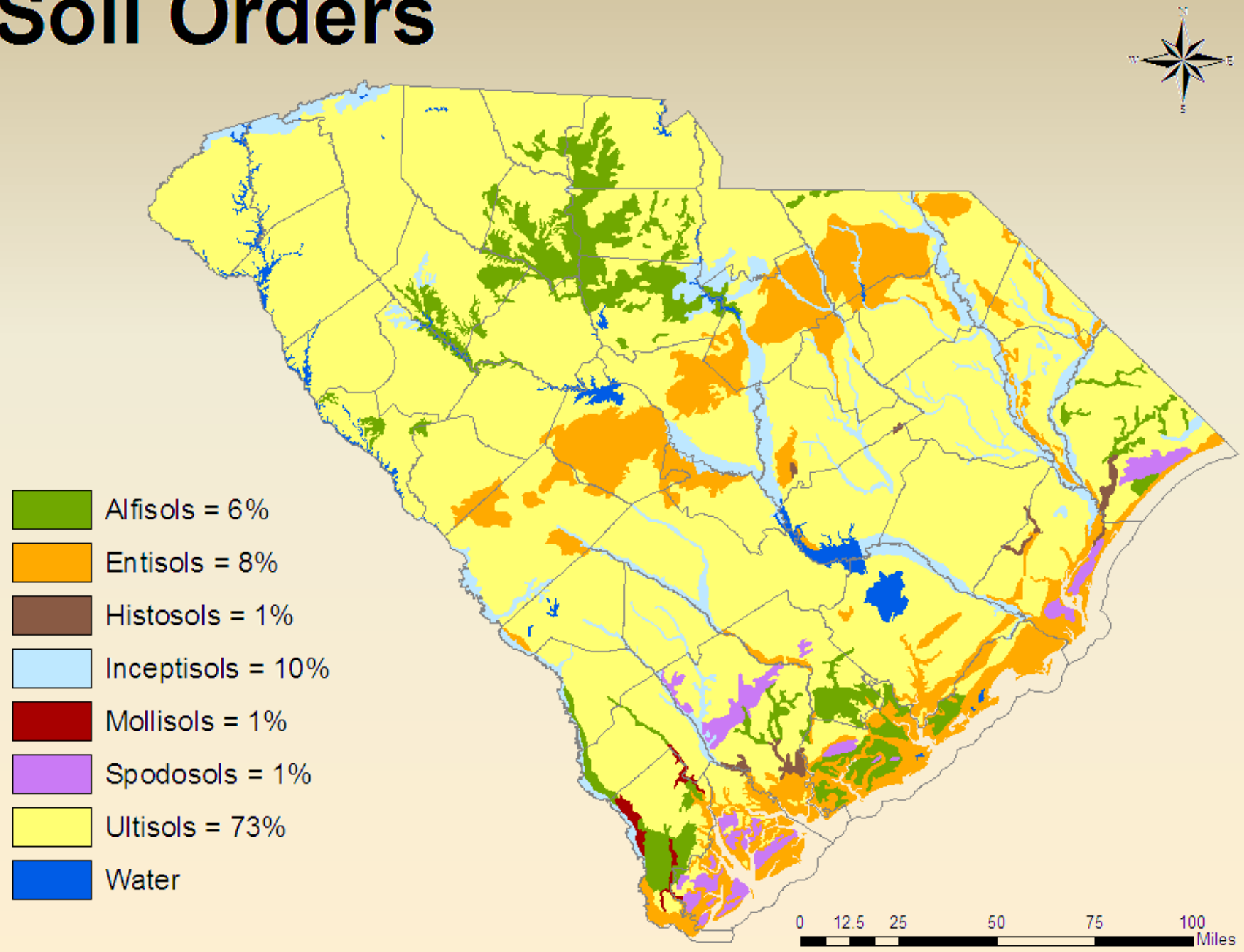
- *Entisols* – little development, usually A-C horizons
- *Inceptisols* – little more development, Bw horizons
- *Alfisols* – argillic/kandic horizon (Bt) less than 2 m, base saturation is > 35%
- *Ultisols* – argillic/kandic horizon (Bt) less than 2 m, base saturation is < 35%
- *Mollisols* – dark, high organic matter, high native fertility
- *Spodosols* – spodic horizon (Bhs), high in subsoil Fe/Al and/or humus
- *Histosols* – organic soils



*Coastal Plain

**Great Smoky NP

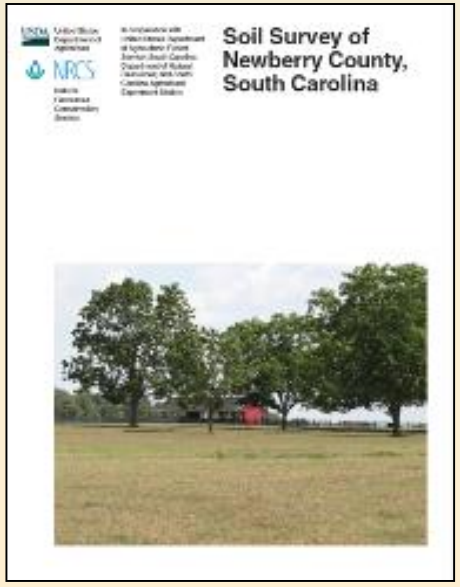
Soil Orders


Alfisols = 6%
Entisols = 8%
Histosols = 1%
Inceptisols = 10%
Mollisols = 1%
Spodosols = 1%
Ultisols = 73%
Water
0 12.5 25 50 75 100
Miles


Soil Survey

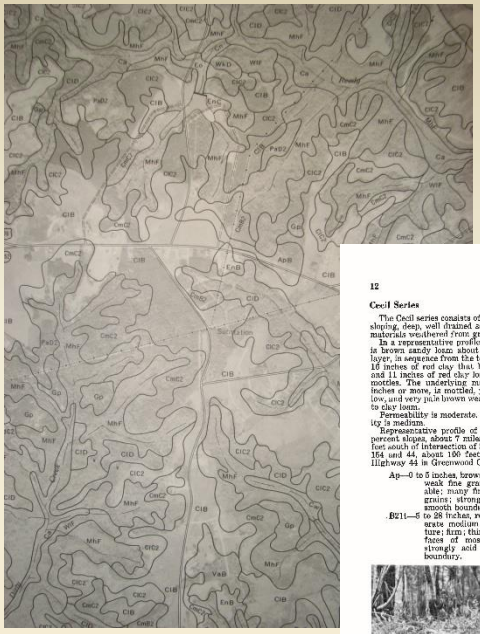
Soil Mapping or Surveying

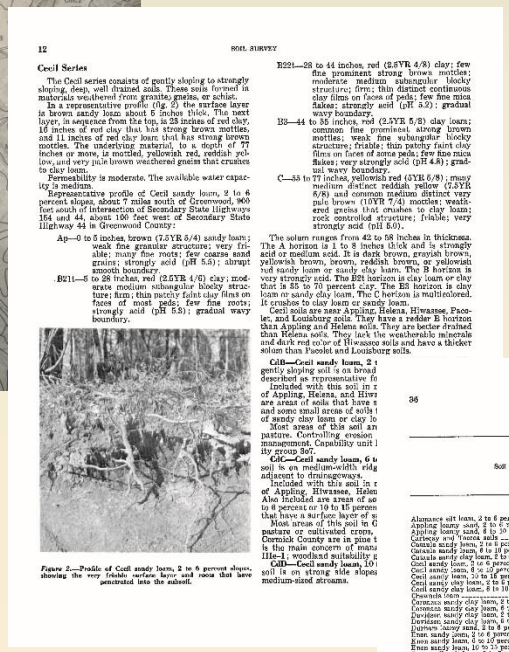
Soil mapping is a method to inventory the different types of soils in a survey area.



Made up of 3 Parts

- Soil Maps
- Soil Descriptions
- Suitability Ratings





12 SOIL SURVEY

Cecil Series

The Cecil series consists of gently sloping to strongly sloping, deep, well drained soils. These soils formed in materials weathered from granite, gneiss, or schist.

In a representative profile (fig. 2) the surface layer is brown sandy loam about 6 inches thick. The next layer, in sequence from the top, is 28 inches of red clay, 16 inches of red clay that has strong brown mottles, and 11 inches of red clay loam that has strong brown mottles. The underlying material, to a depth of 77 inches or more, is mottled, yellowish red, reddish yellow, and very pale brown weathered gneiss that crushes to clay loam.

Permeability is moderate. The available water capacity is medium.

Representative profile of Cecil sandy loam, 2 to 6 percent slopes, about 7 miles south of Greenwood, 960 feet south of intersection of Secondary State Highways 254 and 44, about 100 feet west of Secondary State Highway 44 in Greenwood County:

Ap—0 to 6 inches, brown (7.5YR 5/4) sandy loam; weak fine granular structure; very friable; many fine roots; few coarse sand grains; strongly acid (pH 5.5); abrupt smooth boundary.

B21—6 to 28 inches, red (2.5YR 4/6) clay; moderate medium subangular blocky structure; firm; thin patchy faint clay films on faces of most peds; few fine roots; strongly acid (pH 5.5); gradual wavy boundary.

B221—28 to 44 inches, red (2.5YR 4/8) clay; few fine prominent strong brown mottles; moderate medium subangular blocky structure; firm; thin distinct continuous clay films on faces of peds; few fine mica flakes; strongly acid (pH 5.2); gradual wavy boundary.

B3—44 to 55 inches, red (2.5YR 5/8) clay loam; common fine prominent strong brown mottles; weak fine subangular blocky structure; friable; thin patchy faint clay films on faces of some peds; few fine mica flakes; very strongly acid (pH 4.8); gradual wavy boundary.

C—55 to 77 inches, yellowish red (5YR 5/8); many medium distinct reddish yellow (7.5YR 6/8) and common medium distinct very pale brown (10YR 7/4) mottles; weathered gneiss that crushes to clay loam; rock controlled structure; friable; very strongly acid (pH 5.0).

The solum ranges from 42 to 58 inches in thickness. The A horizon is 1 to 8 inches thick and is strongly acid or medium acid. It is dark brown, grayish brown, yellowish brown, brown, reddish brown, or yellowish red sandy loam or sandy clay loam. The B horizon is very strongly acid. The B21 horizon is clay loam or clay that is 35 to 70 percent clay. The B3 horizon is clay loam or sandy clay loam. The C horizon is multicolored. It crushes to clay loam or sandy loam.

Cecil soils are near Appling, Helena, Hiwassee, Pacolet, and Louisburg soils. They have a redder B horizon than Appling and Helena soils. They are better drained than Helena soils. They lack the weatherable minerals and dark red color of Hiwassee soils and have a thicker solum than Pacolet and Louisburg soils.

CdB—Cecil sandy loam, 2 t
gently sloping soil is on broad
described as representative fo
Included with this soil in r
of Appling, Helena, and Hiwa
are areas of soils that have s
and some small areas of soils
of sandy clay loam or clay lo
Most areas of this soil an
pasture. Controlling erosion
management. Capability unit I
by group 3s7.

CdC—Cecil sandy loam, 6 t
soil is on medium-width ridg
adjacent to drainageways.
Included with this soil in r
of Appling, Hiwassee, Helen
Also included are areas of so
to 6 percent or 10 to 15 percen
that have a surface layer of s
Most areas of this soil in G
pasture or cultivated crops,
Cormick County are in pine t
is the main concern of manag
IIIe–1; woodland suitability g

CdD—Cecil sandy loam, 10
soil is on strong side slopes
medium-sized streams.

Figure 2.—Profile of Cecil sandy loam, 2 to 6 percent slopes, showing the very friable surface layer and roots that have penetrated into the subsoil.

36 SOIL SURVEY

TABLE 2.—*Estimated acre yields of crops grown under a high level of*

[Absence of yield indicates that crop is not generally grown on that soil. Only arable soils are listed.

Soil	Corn		Cotton (1/2 t)		Soybeans	
	Yield	Suitability	Yield	Suitability	Yield	Suitability
	Bu		Lbs		Bu	
Alamance silt loam, 2 to 6 percent slopes	80	2	550	2	30	2
Appling loamy sand, 2 to 6 percent slopes	90	1	700	1	35	2
Appling loamy sand, 6 to 10 percent slopes	80	2	600	1	29	2
Cartecay and Toccoa soils	85	1		4	39	2
Cataula sandy loam, 2 to 6 percent slopes	65	2	475	1	26	2
Cataula sandy loam, 6 to 10 percent slopes	55	3	350	2	20	3
Cataula sandy clay loam, 2 to 6 percent slopes, eroded	45	3	300	2	20	3
Cecil sandy loam, 2 to 6 percent slopes	85	1	750	1	40	1
Cecil sandy loam, 6 to 10 percent slopes	65	2	575	1	35	2
Cecil sandy loam, 10 to 15 percent slopes	45	3	400	2	25	3
Cecil sandy clay loam, 2 to 6 percent slopes, eroded	70	2	525	1	33	2
Cecil sandy clay loam, 6 to 10 percent slopes, eroded	50	3	400	2	25	3
Chewacla loam	90	1		4	45	2
Clifford clay loam, 2 to 6 percent slopes	80	2	500	2	28	2
Cornsilk sandy clay loam, 6 to 10 percent slopes	65	3	400	3	30	3
Davidson sandy clay loam, 2 to 6 percent slopes	90	1	650	1	45	1
Davidson sandy clay loam, 6 to 10 percent slopes	75	2	575	2	40	2
Durham loamy sand, 2 to 6 percent slopes	60	3	450	2	30	2
Enon sandy loam, 2 to 6 percent slopes	75	2	550	1	35	2
Enon sandy loam, 6 to 10 percent slopes	65	3	500	2	30	2
Enon sandy loam, 10 to 15 percent slopes	55	3	400	2	30	3
Georgeville silt loam, 2 to 6 percent slopes	85	1	650	1	40	1
Georgeville silt loam, 6 to 10 percent slopes	75	2	600	1	35	2
Georgeville silty clay loam, 2 to 6 percent slopes, eroded	70	2	500	2	30	2
Georgeville silty clay loam, 6 to 10 percent slopes, eroded	55	3	400	3	28	3
Good loamy sand, 2 to 6 percent slopes	70	2	525	2	35	2
Helena loamy sand, 6 to 10 percent slopes	60	3	450	2	30	2
Herndon silt loam, 2 to 6 percent slopes	85	1	650	1	38	2
Herndon silt loam, 6 to 10 percent slopes	75	2	550	2	30	2
Hiwassee sandy loam, 2 to 6 percent slopes	90	1	600	1	40	1
Hiwassee sandy loam, 6 to 10 percent slopes	85	2	500	2	35	2
Hiwassee sandy loam, 10 to 15 percent slopes	70	3	400	3	28	3
Hiwassee sandy clay loam, 2 to 6 percent slopes, eroded	70	2	500	2	30	2
Hiwassee sandy clay loam, 6 to 10 percent slopes, eroded	60	3	375	3	25	3
Iredell sandy loam, 2 to 6 percent slopes	60	3	700	1	30	2
Iredell sandy loam, 6 to 10 percent slopes	50	3	600	1	40	1
Kirksey silt loam, 2 to 6 percent slopes	60	3	600	1	30	2
Kirksey silt loam, 6 to 10 percent slopes	50	3	500	2	25	3
Louisburg loamy sand, 6 to 10 percent slopes	45	3	350	3	25	3
Mecklenburg sandy loam, 2 to 6 percent slopes	75	2	550	2	35	2
Mecklenburg sandy loam, 6 to 10 percent slopes	70	2	450	2	30	2
Nason silt loam, 10 to 15 percent slopes	70	2	550	2	30	2
Tarrum silt loam, 10 to 15 percent slopes	75	2	400	3	25	3
Wehadkee soils	65	3		4	25	3

[1] AUM is an abbreviation for animal-unit-month. It is a measure of the forage or feed required to maintain one animal unit for

woodland managers will generally favor in intermediate or improved cuttings.

The potential productivity of the soils for trees is given in terms of site index. Site index is the average height of the dominant trees in the stand, to the nearest 10 feet, at age 20 for cottonwood, at age 50 for sycamore, and at age 50 for all other species or types. Average annual growth for natural unmanaged stands, by site indexes at 50 years, is shown in figures 7 (3) and 8 (4). Merchantable volume for loblolly pine plantations, by site indexes at 25 years, is shown in figure 9 (7). Data on growth and yields of unmanaged stands are not a true measure of potential productivity of stands that are managed, but such information permits a comparison of productivity between sites or between species on the same site.

Erosion hazard refers to the risk of soil losses in well managed woodland. Erosion hazard is *slight* if ex-

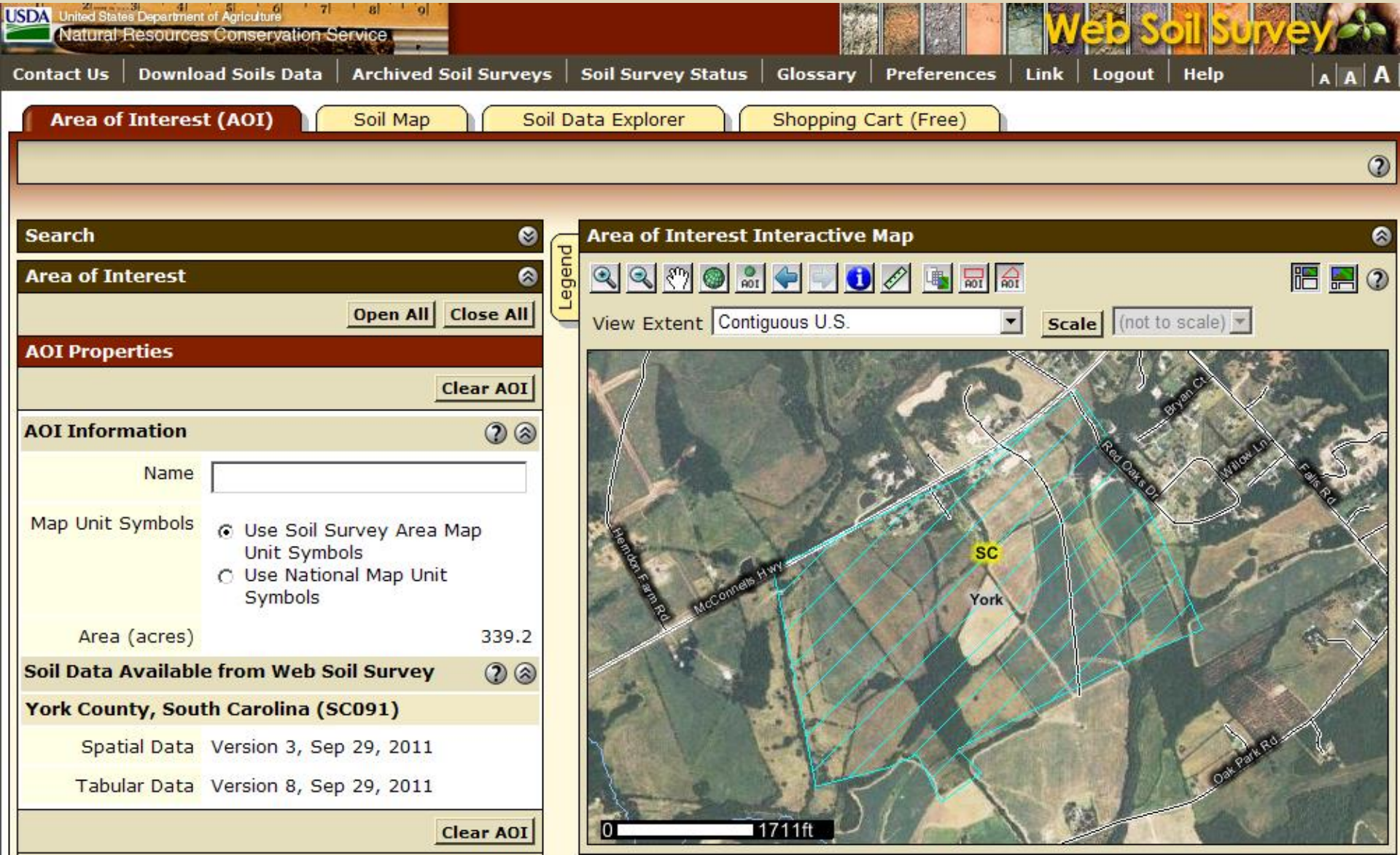
Web Soil Survey

http://websoilsurvey.nrcs.usda.gov

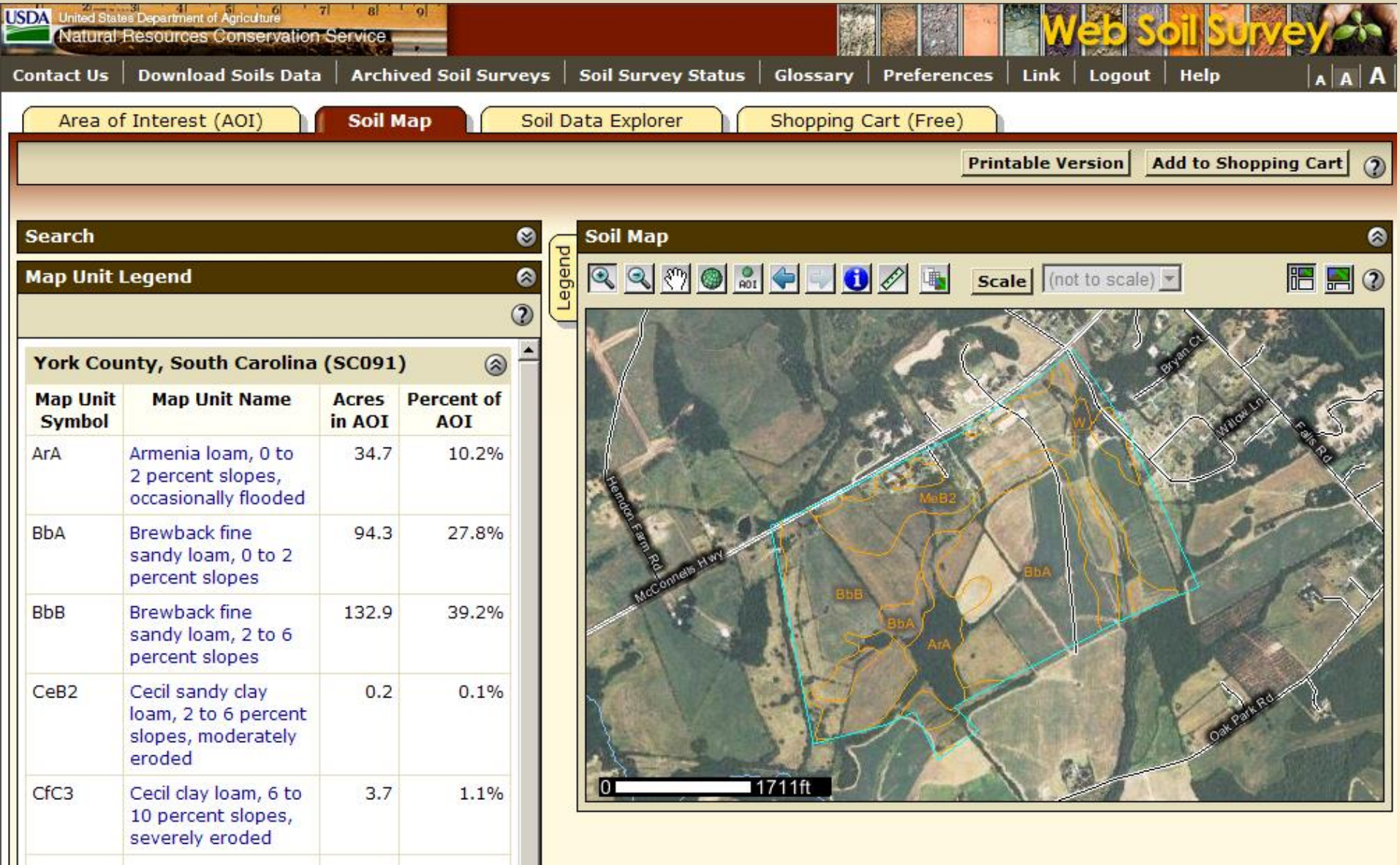
- Wed-based version of the soil survey
- All SC counties are available, as well as most counties in the nation

Web Soil Survey

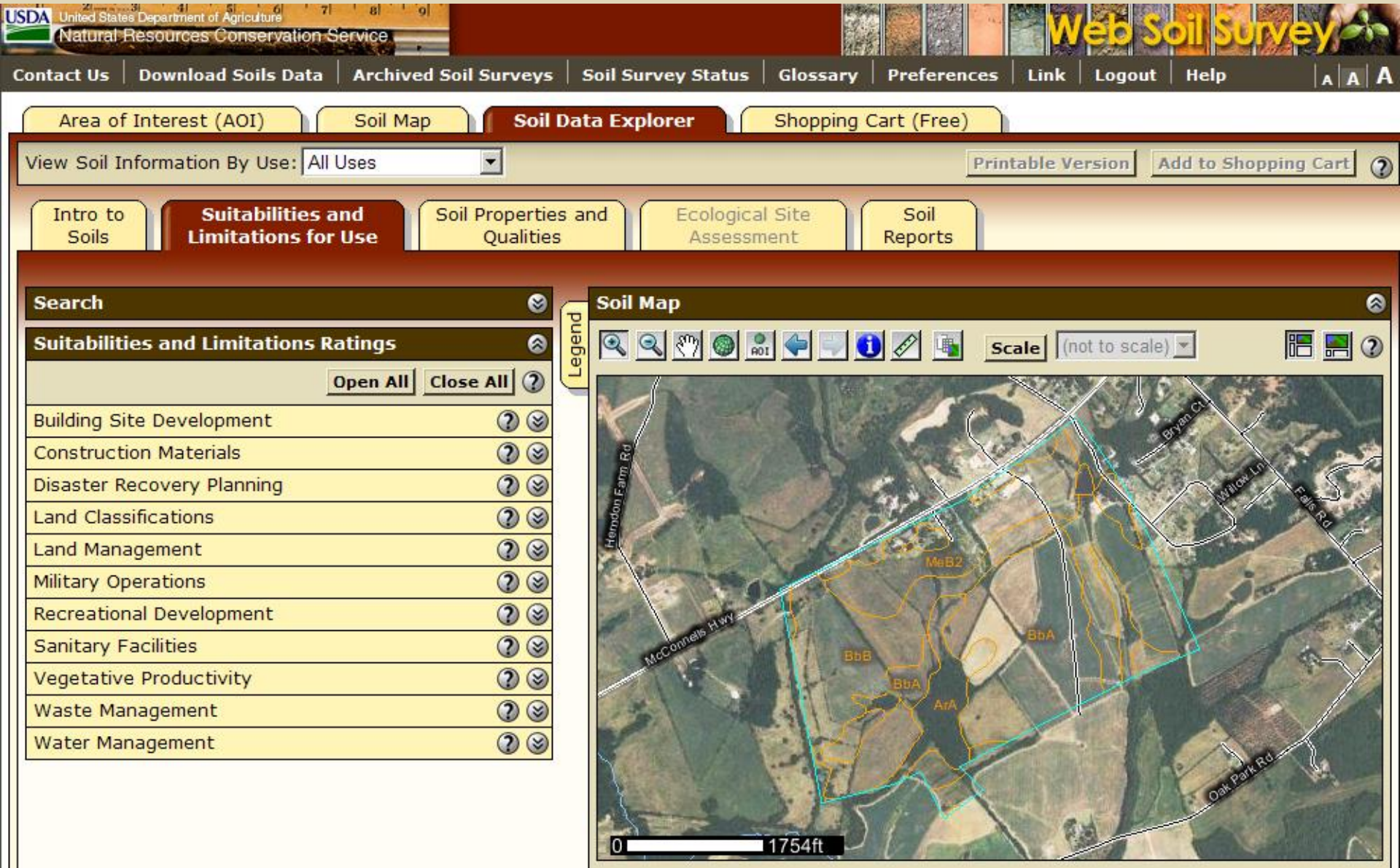
Area of Interest



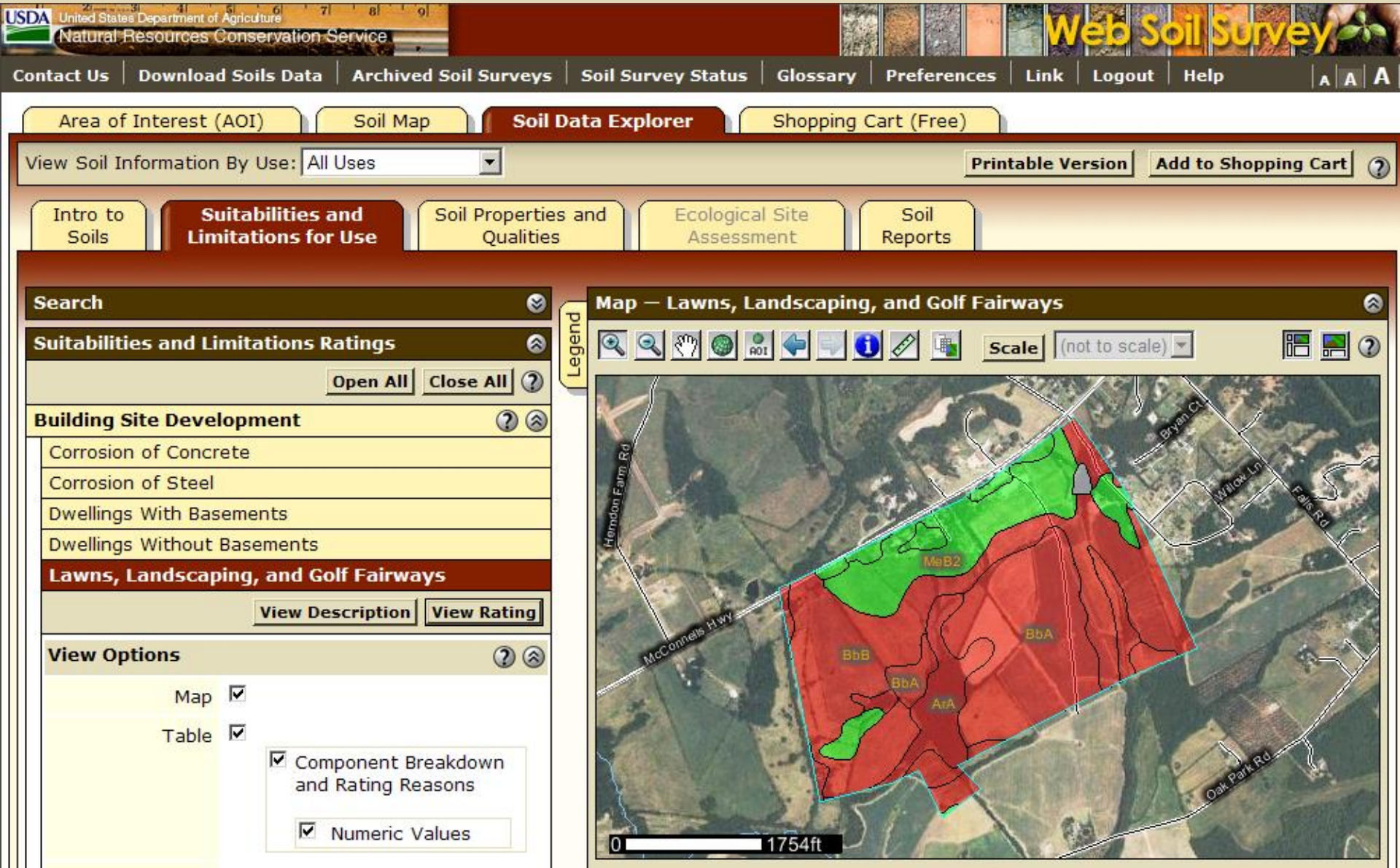
Soil Map/Soil Descriptions



Suitability Ratings



Suitability Ratings



Suitability Ratings

Lawns, Landscaping, and Golf Fairways

Lawns, Landscaping, and Golf Fairways— Summary by Map Unit — York County, South Carolina (SC091)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
AoA	Armenia loam, 0 to 2 percent slopes, occasionally flooded	Very limited	Armenia, occasionally flooded (66%)	Depth to saturated zone (1.00)	34.6	10.5%
				Flooding (0.60)		
			Wickham, occasionally flooded (14%)	Depth to saturated zone (1.00)		
				Flooding (0.60)		
BbA	Brewback fine sandy loam, 0 to 2 percent slopes	Very limited	Brewback (80%)	Depth to saturated zone (1.00)	94.9	28.7%
				Depth to bedrock (0.06)		
BbB	Brewback fine sandy loam, 2 to 6 percent slopes	Very limited	Brewback (80%)	Depth to saturated zone (1.00)	124.7	37.7%
				Depth to bedrock (0.06)		
CeB2	Cecil sandy clay loam, 2 to 6 percent slopes, moderately eroded	Not limited	Cecil, moderately eroded (86%)		1.0	0.3%
CfC3	Cecil clay loam, 6 to 10 percent slopes, severely eroded	Not limited	Cecil, severely eroded (97%)		4.4	1.3%
ChA	Chewacla loam, 0 to 2 percent slopes, frequently flooded	Very limited	Chewacla, frequently flooded (80%)	Flooding (1.00)	2.9	0.9%
				Depth to saturated zone (1.00)		
			Wehadkee, inundated (5%)	Ponding (1.00)		
				Flooding (1.00)		
				Depth to saturated zone (1.00)		
MeB2	Mecklenburg-Wynott complex, 2 to 6 percent slopes, moderately eroded	Not limited	Mecklenburg, moderately eroded (50%)		56.7	17.1%
			Winnsboro, moderately eroded (14%)			
MkE3	Mecklenburg-Wynott complex, 2 to 6 percent slopes, severely eroded	Not limited	Mecklenburg, severely eroded (50%)		3.8	1.1%
			Cecil, severely eroded (20%)			
MkC3	Mecklenburg-Wynott complex, 6 to 10 percent slopes, severely eroded	Not limited	Mecklenburg, severely eroded (50%)		6.3	1.9%
			Cecil, severely eroded (20%)			
W	Water	Not rated	Water (100%)		1.7	0.5%
Totals for Area of Interest					330.8	100.0%

Lawns, Landscaping, and Golf Fairways–York County, South Carolina

Description

This interpretation rates soils for their use in establishing and maintaining turf for lawns and golf fairways and ornamental trees and shrubs for residential or commercial landscaping. Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required.

The ratings are based on the use of soil material at the site, which may have been altered by some land smoothing. Irrigation may or may not be needed and is not a criterion in rating. The ratings are based on the soil properties that affect plant growth and trafficability after vegetation is established. The properties that affect plant growth are reaction; depth to a water table; ponding; depth to bedrock or a cemented pan; the available water capacity in the upper 40 inches; the content of salts, sodium, or calcium carbonate; and sulfidic materials. The properties that affect trafficability are flooding, depth to a water table, ponding, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer. The suitability of the soil for traps, tees, roughs, and greens is not considered in the ratings.

Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. Soils that are subject to flooding are limited by the duration and intensity of flooding and the season when flooding occurs. In planning for lawns, landscaping, or golf fairways, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

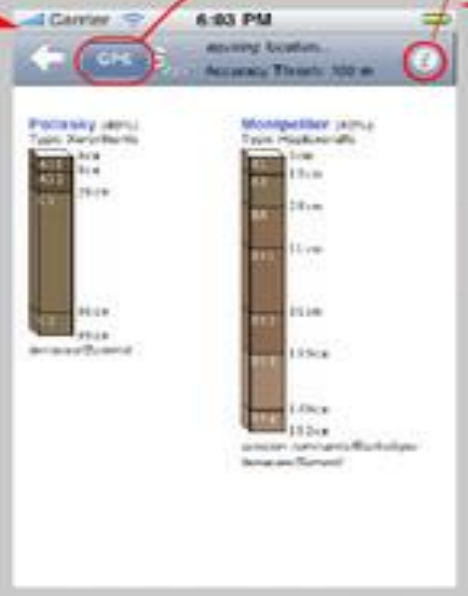
Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Soil Web App

Set the desired GPS accuracy with the slider, and click "Done" to return to the main view.

Click to start application



Application starts with GPS disabled. Click "GPS" to start acquiring location data. Click on the "info" button for application details.

Once a location with sufficient accuracy is acquired, map unit components are displayed. Soil profiles link to their Official Series Description

Component names are linked to their details on the CA Soil Resource page. Use the "back" arrow to return to the main view.

Soil Health

Battle Starts Here

What is Soil Health?

- Once referred to as soil quality
- Defined as how well a soil does what we want it to do
  - Bountiful crops and forests
  - Productive grazing lands
  - Clean air and water
  - Diverse wildlife
  - Beautiful landscapes

Four Basic Soil Health Principles

- Use plant diversity to increase diversity in the soil
- Manage soils more by disturbing them less
- Keep plants growing throughout the year to feed the soil
- Keep the soil covered as much as possible

What's Critical about Soil Health Now?

- World population projected to increase to >9 billion by 2050
- Between 1982-2007, 14 million acres of prime farmland in the US were lost to development
- Improving soil health is the key to long-term, sustainable agricultural production

What Are the Benefits of a Healthy Soil?

- Healthy soil holds more water (and loses less water to runoff and evaporation)
- Organic matter builds as tillage declines and plants and residue cover the soil
- Organic matter holds 18-20 times its weight in water and recycles nutrients for plants to use

What Are the Benefits of a Healthy Soil?

- One percent of organic matter in the top six inches of soil would hold approximately 27,000 gallons of water per acre!
- Most farmers can increase their soil organic matter in 3 to 10 years if they are motivated about adopting conservation practices to achieve this goal.

Conclusion

South Carolina soils are variable but with the right planning, these soils can meet our needs without damaging or destroying them.


THE END